**BEFORE THE**
**FEDERAL COMMUNICATIONS COMMISSION**
**WASHINGTON, D.C. 20554**

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| In the Matter of | ) | |
| | ) | |
| Inquiry Regarding Carrier Current Systems | ) | ET Docket No. 03-104 |
| Including Broadband over Power Line Systems | ) | |

## REPLY COMMENTS

Main.net Communications Ltd. ("Main.net") hereby submits its Reply Comments regarding the above-referenced *Notice of Inquiry* proceeding.[1] In Comments to this proceeding, Main.net and others demonstrated that BPL operations under Part 15 of the Commission's rules do not cause harmful interference to communication services and that medium voltage access BPL equipment should be governed by more relaxed (Class A) interference standards. The filings submitted by other parties to this proceeding do not invalidate those conclusions. Accordingly, consistent with its Comments, Main.net urges the Commission to continue to regulate BPL operations under Part 15 of the Commission's rules and to take actions that support the rapid deployment of BPL technology.

## BACKGROUND

Main.net and its subsidiaries develop and market to power utilities and operators a complete, flexible, and cost-effective broadband communication system operating over low and medium voltage power lines. Main.net's systems provide a much needed alternative platform for the provision of broadband services. In its Comments, Main.net described in detail its BPL technology, the Power Line Ultimate System. Main.net discussed and demonstrated, through the

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[1] *Inquiry Regarding Carrier Current Systems, Including Broadband over Power Line Systems,* Notice of Inquiry, ET Docket No. 03-104 (April 28, 2003).

results of in-house and access BPL interference tests, how provision of BPL communications under the Commission's Part 15 rules cause only benign interference to other communication services. Numerous other parties filed comments reaching similar conclusions about BPL operations.[2] In its Comments, Main.net also proposed specific and more accurate methods for measuring interference from BPL systems and proposed limits based on those methods.

In comments to this proceeding, a group, consisting largely of amateur radio enthusiasts, alleged that BPL operations would cause interference to communications services operating in the same or neighboring frequencies.[3] In support of these claims, a few of the commenters submitted their own internal studies.[4] Others referred to studies conducted in countries in the European Union ("EU") and elsewhere, and suggested that the regulatory authorities in such countries are hostile to BPL deployment.[5]

**Discussion**

The concerns regarding interference to communications services operating in the same or neighboring frequencies as BPL operations are misplaced. As demonstrated in the Reply

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[2] *See, e.g.*, Comments, Ameren Energy Communications, Inc. (July 7, 2003); Comments, Southern LINC, *et al.* (July 7, 2003).

[3] *See* Comments, National Association for Amateur Radio (July 7, 2003) (alleging harmful interference to amateur radio operations); *see also* Comments, North American Shortwave Association (July 7, 2003) (alleging harmful interference to international shortwave broadcasts); Comments, National Academy of Sciences (July 7, 2003) (alleging harmful interference to the radio astronomy service).

[4] *See, e.g.,* Exhibit A to C attached to Comments, National Association for Amateur Radio (July 7, 2003).

[5] *See, e.g.*, Comments, North American Shortwave Association, at 1, 9-12 (June 30, 2003) (stating that the Dutch and Finnish government had rejected the deployment of BPL systems); Comments, National Association of Shortwave Broadcasters, at 2 (July 3, 2003); Comments, The Association For Maximum Service Television, Inc. and the National Association of Broadcasters, at 11 (July 7, 2003).

Comments of Ameren Energy Communications, Inc. ("AEC"),[6] the technical analyses suggesting that BPL causes such interference are characterized by two incorrect, fundamental assumptions — that power lines act as continuous radiation sources and that radiation effects are cumulative within a single BPL cell.[7] In fact, a power line transmitting waves does not behave as a continuous radiation source but, in fact, radiates only at points of discontinuity. Also, radiation effects from a BPL cell are not cumulative because only one modem emits at any given time within a single BPL cell.[8] Consideration of these factors eliminates the interference concerns raised by the parties.

Furthermore, attached hereto at Exhibit 1 is a technical statement prepared by Professor Holger Hirsch clarifying several issues raised in initial comments. Prof. Hirsch notes that several commenters make erroneous assumptions regarding the operation of BPL systems and their potential for interference. Prof. Hirsch notes, among other things, that concerns regarding BPL's potential for causing interference to DTV operations are misplaced, as BPL systems will generally operate well below DTV in the spectrum and BPL emissions will be comparable to white noise, not impulse noise as assumed by DTV proponents. Similarly, concerns about the immunity of BPL to amateur radio operations are outdated and no longer an issue for modern BPL equipment.

Main.net also seeks to dispel the suggestion that regulatory authorities in countries in the EU are hostile to the deployment of BPL because of concerns regarding interference. In fact, the

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[6] AEC provided a draft version to Main.net prior to the filing of the AEC Reply.

[7] *See* Reply Comments, Ameren Energy Communications, Inc (August 20, 2003); *see also* Comments, Current Technologies, LLC, at 14-15 (July 7, 2003).

[8] *See also* Comments, Main.net, at 6 ("[E]ven if hundreds of units are installed, only one unit is transmitting on any given frequency at any given time in an area.").

existing EU regulatory framework is favorable to the deployment of BPL systems. Pursuant to an European Commission ("EC") Directive, companies whose equipment is approved by an EU Competent Body are permitted to deploy BPL systems in all member states of the EU.[9] Main.net itself has such approval (as do other companies), and its products are sold commercially in the European market.[10] While there have been allegations of interference in the EU, largely from amateur radio enthusiasts, such claims have been unsubstantiated, and no national regulatory authority has recognized that BPL operations have been the cause of any of the complaints.[11] The importance of power line communications for the European Commission is underscored by the intention to make substantial funds for research available in this field in the Commission's next funding cycle.

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[9] *See* Eurpoean Commision Directive 89/336/EEC as amended by Directive 91/263/EEC, Directive 92/31/EEC, and Directive 93/68/EEC, *available at* http://europa.eu.int/comm/enterprise/electr_equipment/emc/directiv/text.htm#art1.

[10] A copy of one of Main.net's authorization is attached as Exhibit 2.

[11] An EU member state has authority to resolve interference complaints under its own national regulations.

## Conclusion

For these reasons and those provided in its Comments, Main.net urges the Commission to continue to regulate BPL operations under Part 15 of the Commission's rules and to take action that supports the rapid deployment of BPL technology.

Respectfully submitted,

By: *_/s/ Joseph A. Marsilii, Jr._*

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Dated: August 20, 2003

# Exhibit 1

# Comments on the Replies on the Inquiry Regarding Carrier Current Systems, Including Broadband Over Power Line Systems by the FCC

Holger Hirsch, 16.08.03

Prof. Holger Hirsch began his career at an electromagnetic compatibility (EMC) test lab in Dortmund, Germany as the head of the test lab and competent body according to European Commission Directive 89/336/EEC. More recently, he was a Professor and the manager of the division of "Theory of EMC" at the University of Dortmund, Germany. In this position, his scientific activities were in the following fields: general questions on EMC measurement procedures, EMC behaviour of modern electronic systems in vehicles, numerical field calculations, and EMC of power line communication systems. Since March 2003, he has served as the chair of the "Electrical Power Transmission" division at the University of Duisburg-Essen, Germany. In this position, Prof. Hirsch studies High Voltage Engineering and Energy Storage, as well as continuing study in the scientific subjects mentioned above.

**1. BPL Transmissions Do Not Resemble Impulse Noise**

Contrary to concerns raised by some commenters, emissions from Broadband Power Line (BPL) systems are actually similar to white noise rather than impulse noise, and therefore, are less likely to cause interference to DTV operations. The Joint Comments of the Association for Maximum Service Television, Inc. and the National Association of Broadcasters argue that due to the broadband character of BPL frequency spectrum the potential for interference to DTV is high. If one were to look exclusively at the absolute value of the spectral density of BPL emissions it would appear similar to that of impulse noise, however, looking solely at the absolute value does not give a true picture of BPL. This misperception, combined with the fact that digital television (DTV) systems are apparently impaired by impulse noise, leads these commenters to conclude that BPL will cause interference to DTV systems if they both operate in the same frequency range. In fact, however, it is clear that when the phase information is also included in assessing BPL emissions BPL is in fact more comparable to white noise than to impulse noise. This is also made clear by analyzing a typical output stage of a BPL modem. Due to its design, this output stage cannot produce more than some 100mV to some few volt. Thus, results showing the reaction of DTV systems to impulse noise cannot lead tot he conclusion that BPL leads to the same reaction.

In addition to the fact that any spurious, out-of-band emissions caused by BPL devices will comply with the Part 15 limitations and be no different than emissions permitted by existing electronic devices, BPL systems currently use frequencies below 30 MHz. In contrast, DTV stations operate on frequencies above 54 MHz.

**2. Subjecting Medium Voltage BPL Devices to Class A Limits Reduces Their Aggregate Impact**

Classifying BPL devices that operate on medium voltage lines as Class A devices is preferable, as it reduces the number of units necessary to operate an effective system, thereby reducing the overall emissions from the BPL network. In several comments (e.g. [3] and [4]), the authors are concerned that a high pass bridge in parallel to the distribution transformer will lead to high penetrations with BPL signals. Several transformers are connected to a typical medium voltage line. In many cases the line geometry is not constant along the line. This results in discontinuities in the propagation behavior and therefore to high signal attenuation, which is the reason for the use of repeaters within a BPL network. Consequently, the uncontrolled pollution of the medium voltage system is not possible.

Residential power consumers do not directly use medium voltage level. Only industrial users are directly connected to medium voltage lines. Thus, even if a high pass filter bridge is installed in parallel to a distribution transformer, there will be attenuation between medium and low voltage lines.

From a theoretically point of view, a BPL system on medium voltage could be built with class B-compliant equipment using additional repeaters to make signal transmission over long distances

possible. Using class A-compliant equipment for the medium voltage portion of the BPL system, however, significantly reduces the density of repeaters necessary for an effective system. Besides the reduction of costs, the use of class A limits can result in a decrease of radiation in large portions of the BPL network, which is preferable. Due to the attenuation between medium and low voltage lines, the class B limits applicable to devices employed in residential settings are met on the low voltage level.

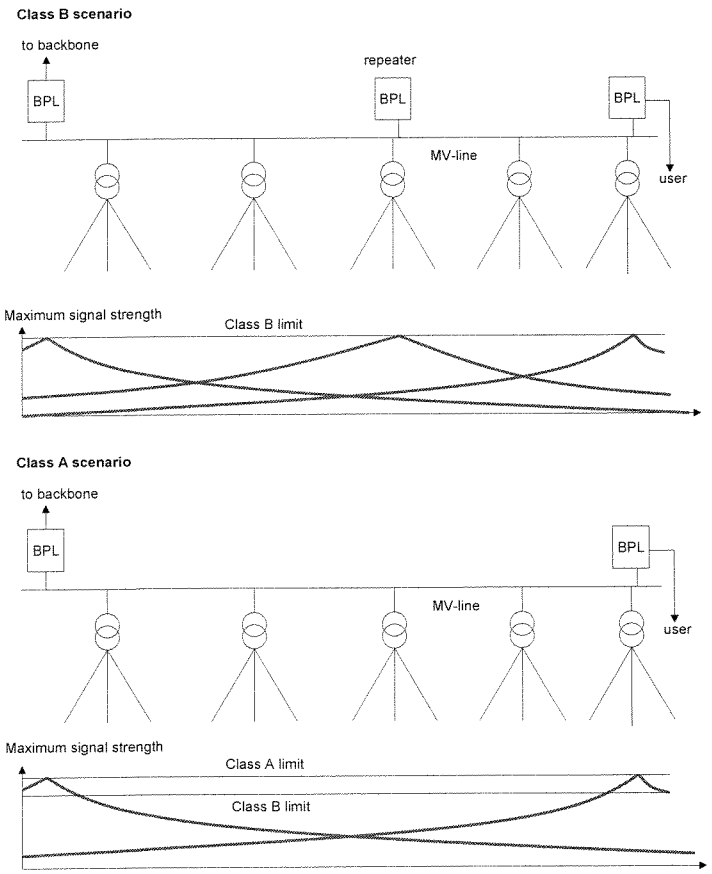


Figure 2 Scenarios for application of class A and class B limits on MV level
(It must be considered, that the transmission of the BPL modems is sequential)

### 3. ARRL's Studies Misstate BPL Antenna Gain and Radiation Patterns

The modeling conducted by the National Association for Amateur Radio (ARRL) attempting to determine the interference potential of BPL equipment is inaccurate. ARRL's comments present the radiation patterns of power lines resulting from numerical simulations. The results are well elaborated. The publication of all relevant data needed for reproducing the results is very helpful and expression of openness and scientific valuable. However, study of the differential injection (e.g. DIP5R3.NEC on page 41 of [4]) model presented in ARRL's comments raises some significant questions: The important wires are those with the tags 3,4,5,6,7 and 8, which build a 2-wire system 200m long and the wire distance 3m. The two ends of the 2-wire system are terminated by 50Ohm. At the center (co ordinates x,y=0.0,0.0) one of the conductors is connected to a vertical wire (pylon?) with four radial wires parallel to the ground plane at the foot point. It appears that under ARRL's model signal feeding is done with a voltage source at about 25% of the total line length on one wire only. From figure 3 it is clear that the scenario modeled by ARRL will lead to high efficiency antenna structures, since the wire around the injection source is driven as dipole. Unfortunately, ARRL's modeling does not reflect how a typical BPL system actually operates. In reality, the injection of signals onto the power lines in typical BPL system is done as a differential mode signal,

i.e. a voltage source between the two wires. As ARRL's calculations fail to consider this scenario, its results are not representative of BPL's true interference potential and are therefore unreliable.

In addition, the same improper model was used for the calculations in Exhibit C: Calculated levels from BPL and their impact on amateur radio communications circuits. Therefore, it can be concluded that the calculations resulting in the statement "all amateur medium-frequency, all HF, and all VHF allocations must be avoided by any access or in-building BPL system without exception," do not reflect real-world installations.

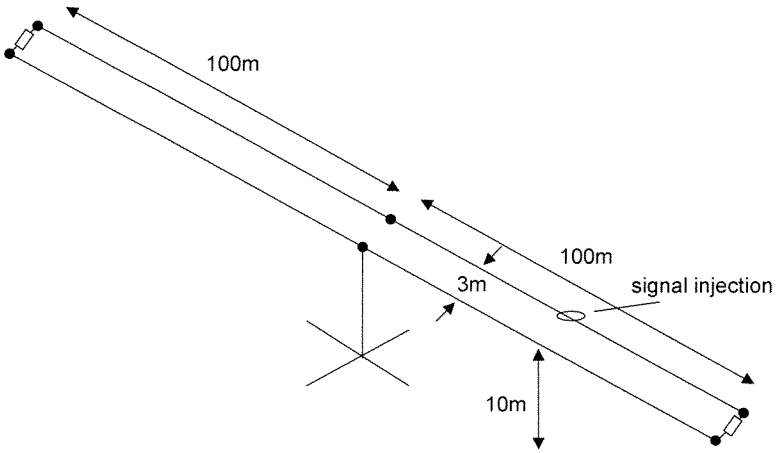


Figure 3 Extract from the model included as Exhibit A in the ARRL reply

It is mentioned in ARRL's comments that the Part 15 radiated emission limits presume the deployment of point-source radiators with localized interference potential and it was concluded that the models are not designed to deal with multiple transmitter or radiating distribution systems operating at or near maximum permitted levels over large geographic areas. There are three facts, which show the applicability of the Part 15 models on BPL:

1) Due to the high attenuation of power lines the radiation character is point-source like
2) The oscillators of BPL modems are not correlated
3) Several BPL modems in a BPL network can not transmit simultaneously

Ultimately, while modeling can prove useful, numerical simulations will necessarily be a simplified, and thus, less precise, means of estimating the actual emissions from a proposed electronic system. Thus, in addition to the fact that ARRL's studies contain a key flaw, modeling is of limited use in determining real world emissions.

**4. ARRL Mischaracterizes the Susceptibility of BPL Equipment**

Contrary to the concerns raised by ARRL, the current generation of BPL equipment is able to withstand interference from amateur radio operations. ARRL raises questions regarding the immunity of BPL systems to amateur radio systems. These objections reflect an out-dated problem that existed some years ago, whereby the power industry argued that power line communications systems operating below 136 kHz were not sufficiently immune to amateur radio. Since that time, however, technology has improved and progressed (especially with regard to modulation and coding methods), such that newer broadband systems are more immune to impulse noise as well as to CW-signals. Today, BPL systems are no different from other electronic equipment with regard to being immune from other frequency users. Notably, CISPR-24 [6] specifies immunity requirements for information technology equipment. In addition to other requirements, tests are performed on such equipment with an amplitude modulated high frequency signal directly coupled in the mains connection port and other ports. A level of 3V emf has to be applied. Of course, in extreme situations this immunity level may be exceeded in case of nearby transmitters, however, the aim of EMC immunity standards is to cover a large percentage of situations occurring in real world situations. The level chosen in CISPR-24 was defined to fulfill this goal. While 100% protection is theoretically possible, it cannot be reached with

finite costs. Thus, if interference situations occur more frequently, it is not simply BPL that would need to be adapted, but also all kinds of electronic systems.

**5. BPL Poses no Greater Interference Threat to Radio Astronomy than Existing Equipment**

BPL poses no greater interference threat to radio astronomy than existing electronic equipment, which coexists with radio astronomy users today. The Comments of the National Academy of Sciences' Committee on Radio Frequencies raises concerns regarding spurious emissions and intermodulation effects, which it fears may interfere with the radio astronomy service. According to the present regulations for current carrier systems, these spurious emissions are handled in the same way as all other electronic equipment. Importantly, BPL systems do not have any special qualities as compared to other types of equipment. Given that the market penetration of other electronic equipment is much higher than that of BPL systems, if there is an interference problem with spurious emissions, it will more likely occur with other equipment.

Intermodulation can occur when two signals with different frequency are injected into a non-linear device. From an academic point of view, such a problem can occur with BPL, just as it can with other types of equipment, such as switching type power supplies, as described in the National Academy's comments. In practice, however, both in field trials and in commercial deployments of BPL systems around the world, such an effect has not been observed as a result of BPL. Again, looking at the number of devices connected to the power line, such effects – if relevant – would already have been observed without BPL.

**References**


[1] Comments of the National Academy of Sciences' Committee on Radio Frequencies.
[2] Joint Comments of the Association for Maximum Service Television, Inc. and the National Association of Broadcasters.
[3] Comments of the North American Short-Wave Association.
[4] Comments of the National Association for Amateur Radio (ARRL).
[5] IEC 61000-4-3:09/2002
[6] CISPR-24:1997 + A1:2001

# Exhibit 2

# Competent Body

***CETECOM***
Certification and Testing
in Communications GmbH
Im Teelbruch 122
D-45219 Essen

**accredited by the**

## Regulierungsbehörde für Telekommunikation und Post

# Certificate

**from a competent body (as defined by § 2 no. 10 of the EMC Act)
within the meaning of § 4 (2) EMC Act
or Article 10 (2) of the EMC Directive
on compliance with the EMC protection requirements with following restriction:**

Not taken into consideration were the effects of the emissions in the range of 150 kHz to 30 MHz, which can be caused by the communication of the powerline modem in the power supply lines. The combination of such devices to a telecommunication net is according to the EMVG 08/98 an installation. The application of the EMVG 08/98 on such an installation is described in "Guidelines on the Application of Council Directive 89/336/EEC" (further notes, see Technical Report).

Certificate no. **02-080**

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| Holder of Certificate: | **m@in.net Communication Ltd.** |
| Manufacturer: | **m@in.net Communication Ltd.** |
| Technical Report, date: | **02-080 dated November 11, 2002** |
| Object identification: | **Plus; Revision: Plus 3.0** |
| Object description: | **Powerline Communication Device** |

This certificate was issued in accordance with Article 10.2 of Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility implemented in the Federal Republic of Germany by § 4 (2) of the Electromagnetic Compatibility Act (EMVG) of 18 September 1998 as published on 24 September 1998 (Federal Law Gazette I p. 2882). This certificate does not testify to compliance with the EMC protection requirements of other laws implementing Directives of the European Community other than Council Directive 89/336/EEC.

**Essen, November 19, 2002**
Place, date

Competent Body